# Device for monitoring the flames of oil burners with adaptive properties

The invention relates to a device for monitoring the flames of oil burners according to the preamble of claim 1.

Such devices for monitoring flames have as a rule a sensor which detects the light of the flame of the burner and generates a corresponding signal therefrom, and an amplifier circuit for evaluating the signal detected by the sensor.

The light of the flame which is to be detected by the sensor has a large range of dynamics depending on the operating state of the oil burner. In a "cold" oil burner, that is to say when the oil burner starts up, only a small signal is detected by the sensor, while in the case of a "hot" oil burner there is a large signal. These dynamics entail the problem that the requirements of sensitivity of such devices vary over time because it is necessary to ensure both reliable starting up and switching off of the oil burner.

In devices for monitoring flames according to the prior art, allowance is not made for the upper range of dynamics, that is to say the sensitivity of the devices for monitoring flames is merely set to a fixed value. A direct consequence is that the method of operation of the devices according to the prior art can only be less than optimum.

As prior art, reference is made to DE-A 196 5[illegible] [illegible] which discloses a method and an arrangement for monitoring and controlling combustion processes. In addition, the prior art comprises EP-A-[illegible] 474 43[illegible], US-A-4 [illegible] 844, US-A-3 903 418, GB-A-1 405 40[illegible] and patent abstracts of Japan Vol. 018, No. 023 (M-1541).

Taking the above as a starting point, the present invention is based on the problem of providing an optimized device for monitoring flames in oil burners.

This problem is solved by means of a device having the features of claim 1.

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Further advantageous refinements of the invention emerge from the subclaims and the description. A preferred exemplary embodiment of the invention is explained in more detail below with reference to the drawing, in which:

Fig. 1 shows a device according to the invention for monitoring flames in oil burners as a schematic block diagram.

The device according to the invention shown in the drawing for monitoring flames in oil burners has a sensor 10 and an amplifier circuit 11 assigned to the sensor 10. The sensor 10 monitors a flame not illustrated of an oil burner likewise not illustrated. Specifically, the sensor 10 is preferably an infrared sensor which detects the light of the flame of the oil burner in the infrared range and generates a corresponding signal 12 therefrom. The amplifier circuit 11 is used for evaluating the signal 12 detected by the sensor 10. For the sake of completeness, it is to be noted that the sensor 10 does not have to be embodied as an infrared sensor. Instead, it is also possible to use other sensors for monitoring the flame of the oil burner.

The amplifier circuit 11 according to the invention automatically adapts its sensitivity to the actual level of the signal 12 detected by the sensor 10. This ensures that the amplifier circuit 11, and thus the

device composed of the sensor 10 and the amplifier circuit 11 and having the purpose of monitoring flames is independent of the state of the burner, that is to say operates reliably over the entire range of dynamics of the flame of the oil burner.

For this purpose, the amplifier circuit 11 has a voltage divider device 13, a filter device 14, a rectifier device 15 and an amplifier device 16. According to figure 1, the signal 12 detected by the sensor 10 and a control signal 17 are used as input variables for the voltage divider device 13. In the voltage divider device 13, which may be embodied as a combination of a fixed resistor and variable resistor, the signal 12 detected by the sensor 10 and the control signal 17 are mathematically combined with one another in such a way that the amplitude of the signal 12 detected by the sensor is set to a defined amplitude. This signal which is set to the defined amplitude is the output signal 18 of the voltage divider device 13 which is fed to the filter device 14 as input signal. The filter device 14 comprises two filters, namely a first bandpass filter 19 and a second bandpass filter 20 connected downstream of the first bandpass filter 19. In the filter device 14, the output signal 18 of the voltage divider 13 is accordingly filtered, and an output signal 21 of the filter device 14 is subsequently fed to the rectifier device 15 which generates a rectified output signal 22 from the output signal 21 present in the form of an alternating voltage. The output signal 22 is consequently a filtered and rectified output signal of the sensor 10 which is set to the defined amplitude. As is apparent from figure 1, the rectifier device 15 has a resistor [illegible] which is connected in series with a diode [illegible], the series circuit composed of the diode [illegible] and the

resistor 24 being respectively connected in parallel with a capacitor 25 and a further resistor 26.

According to figure 1, the output signal 22 of the rectifier device 15 is fed as input signal to the amplifier device 16. Furthermore, a reference signal which is made available by means of appropriately dimensioned resistors 27, 28 and 29 is fed as setpoint value to the amplifier device 16. The reference signal for the amplifier device 16 is tapped between the resistors 27 and 28 in accordance with figure 1. The amplifier device 16 generates the control signal 17 from these input signals. An embodiment of the amplifier device 16 is particularly advantageous if it has a proportional/integral amplification characteristic.

The output signal 22 of the rectifier device 15 is additionally fed to a comparator 30 as input signal which compares the output signal 22 of the rectifier device 15 with a reference value which is tapped between the resistors 29 and 27. This reference value for the comparator 30 is, for example, 70% of the defined amplitude to which the signal 12 determined by the sensor 11 is set in the voltage divider device 13. The comparator 30 makes available, as output variable 31, a flame signal which contains information on the presence or nonpresence of the flame of the oil burner.

Because, as stated above, the amplitude of the signal 12 detected by the sensor 11 is always normalized automatically to the defined amplitude, the sensitivity of the amplifier circuit 10 is optimized over the entire range of dynamics of the flame of the oil burner.

As has already been stated above, the amplifier device 16 has a proportional/integral amplification characteristic. The amplification characteristic of the amplified device 16 is configured here in such a way that an increasing output signal 22 is compensated quickly while a decreasing output signal 22 is compensated slowly. This ensures that in the event of a failure of the flame the output signal 22 drops rapidly below the threshold value of, preferably, 70% and the comparator can thus signal a corresponding failure of the flame reliably and quickly.

The amplification characteristic of the amplifier device 16 can, according to figure 1, also be varied by means of a signal 32. This property is significant if the device according to the invention is to be used in oil burners with multi-setting operation. For example, specifically in conjunction with multi-setting oil burners, when there is a switch-over from one power setting to another setting of the oil burner, a sudden change in the light conditions with respect to the flame of the oil burner may take place. In such a case it is necessary to reliably prevent a reduction, caused by this, in the signal 12 detected by the sensor 10 being interpreted as an extinction or failure of the flame. For this purpose, the amplification characteristic of the amplifier device 16 is set to a maximum in synchronism with a switch-over of the setting of the oil burner. As a result, specifically when there is a switch-over of the setting of the oil burner, the amplifier circuit 11 is accordingly sensitized instantaneously in such a way that when the signal 12 decreases suddenly owing to a switch-over of the setting it is possible to reliably conclude that a flame of the oil burner is present.

Furthermore, the amplifier circuit 11 has a self-test function. For this purpose, the amplifier circuit 11 can be supplied with a self-test signal 33 by means of a second voltage divider device 34. The self-test signal 33 serves here as an input variable for the second voltage divider device 34, an output variable 35 of the second voltage divider device 34 being made available to the filter device 14, namely the first bandpass filter 19, as an input variable. The self-test signal 33 is a sequence of pulses, the amplification of the first bandpass filter 19 being reduced to preferably a third of its nominal amplification by means of the voltage divider device 34 in synchronism with the pulses of the self-test signal 33. An evaluation circuit not illustrated which is connected downstream of the comparator 30 checks whether the comparator 30 detects the signal reduction carried out with the clock of the pulses of the self-test signal 33. If this is the case, the amplifier circuit 11 is operating without faults. It is significant here that the amplification of the first bandpass filter 19 is not reduced to zero by means of the voltage divider device 34 but rather is preferably only divided by three or even halved. If the amplifier device 10 overdrives owing to a fault, the division by three or halving of the amplification of the first bandpass filter 19 is in fact not sufficient for the comparator 30 to be able to react appropriately to the pulses of the self-test signal 33. A fault is thus detected. However, if the amplification of the first bandpass filter 19 has been reduced to zero, the comparator 30 would react to the pulses in the self-test signal even in the case of an overdriving amplifier device 10, and would then not be able to detect the fault.

It is advantageous also if the device according to the invention comprised of the sensor [illegible] and the diaphragm

amplifier circuit 11 is integrated into a digital, microprocessor-controlled controller. With this integration it is in fact possible to use the device according to the invention in an optimum way. For example, a digital microprocessor-controlled controller can directly evaluate the output variable [illegible] of the comparator [illegible]. A digital controller can also reliably and easily generate the self-test signal [illegible] and the signal [illegible]. Furthermore, the control signal 17 can also be easily evaluated. Furthermore, integration of the device according to the invention into a microprocessor also results in a cost saving because the structural design is simplified.

List of reference numerals

10 Sensor
11 Amplifier circuit
12 Signal
13 Voltage divider device
14 Filter device
15 Rectifier device
16 Amplifier device
17 Control signal
18 Output signal
19 Bandpass filter
20 Bandpass filter
21 Output signal
22 Output signal
23 Diode
24 Resistor
25 Capacitor
26 Resistor
27 Resistor
28 Resistor
29 Resistor
30 Comparator
31 Output variable
32 Signal
33 Self-test signal
34 Voltage divider device
35 Output variable